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## Research Mode and Contribution in Interorganizational Information Systems Research

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### Abstract:

We develop a model to analyze the body of knowledge of the information systems (IS) field where research accumulates through the interplay of different modes: discovery, prescriptive, and evaluation. The paper proposes five signature contributions: 1) descriptions of discovery and exploration, 2) elaborations of IS-based means and means-ends propositions, 3) discussions of IS-based designs, 4) explanations of the impacts and impact mechanisms of IS, and 5) discussions of organizational theories of IS-phenomena. We argue that each of these contributions plays an important role in the accumulation of the body of knowledge. In particular, we call for a balance in approaches producing these different contributions. Results from analyzing two samples of published interorganizational information systems (IOS) research in high-tier information systems journal outlets from 1982-2010 supports the applicability of the framework as a useful way to categorize the research stream. In line with prior suggestions, we also found an increased tendency towards explanatory organizational theories in that less work has focused on discovering new practices, developing means, and evaluating their uses. Recent interest in academically rigorous design science research offers a welcome addition to the body of IS research that could broaden its base and enrich its content and contributions.

**Keywords:** Theory, Knowledge Accumulation, Interorganizational Information Systems, IOS, Science of Science, Design Science, IS Research, Research Contributions, Research Policy, Relevance of Research to Practice.

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# 1 Introduction

In recent years, the information systems research community has debated the relevance of research efforts to practice (see, e.g., Orlikowski & Iacono, 2001). This discussion gained momentum in the 1990s with proposals for more design-oriented research as a complement to the paradigm of organizational or explanatory research (Walls, Widemeyer, & El Sawy, 1992; March & Smith, 1995; Hevner, March, Park, & Ram, 2004). One key thrust of these proponents of design science in information systems research is the notion that research that aims to be relevant to IS practice should also address the design of artifacts and not only explain the phenomena surrounding their application.

Straub and Ang (2008) defined the problem of relevancy by focusing on two gaps: accessibility of results (practitioner-friendly writing) and choice of topics. While the accessibility of journal papers aimed at academic audiences might be an irrelevant target (Lyytinen, 1999), the choice of topics remains an important point of leverage. Straub and Ang noted that practitioners prefer prescriptions and design knowledge that can solve real-world problems, while academics favor explanations of phenomena. Thus, Straub and Ang proposed broadening thematic choices from know-why towards evidence-based prescriptions. As an important contribution to this discussion, Gregor (2006) developed a holistic account of the nature of theory in IS research and showed the multitude of ways in which information systems research can contribute to both theory and practice. In particular, Gregor suggested five distinct types of theories in IS research: 1) analysis (what is), 2) explanation (what is, how, why, when, and where), 3) prediction (what is and what will be), 4) explanation and prediction (combining the two previous types), and 5) design and action (how to do something).

Yet, what relevance means in the practice of conducting IS research remains ambiguous (Davenport & Markus, 1999; Lyytinen, 1999; Baskerville & Myers, 2004; Rosemann & Vessey, 2008; Klein & Rowe, 2008; Straub & Ang, 2008; Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011). Also important is question of how descriptive and prescriptive (March & Smith, 1995) scientific interests relate to each other. One conclusion that we can draw from this discussion is that we do not have adequate tools to understand and analyze the varying types of IS research—particularly the role and interplay of different types of research projects in terms of their results.

In this paper, we approach the question of the nature of IS research through the perspective of the science of science (Klahr, 2000). We can see Herbert Simon's (1996) argument that IS research has a need for a science of design in addition to the sciences of nature and the social sciences in this larger context of the science of science. In essence:

*Such study may lead to better science. What we learn about the science of science leads into a kind of "engineering of science" in which—as in other areas—we use our knowledge of a natural process to create artifacts that accomplish the same ends by improved means. (Klahr 2000, p. 6).*

Some examples of the science of science include Gregor's (2006) description of theoretical contributions in the field of information systems research, Peffers, Tuunanen, Rothernberger, and Chatterjee's (2007) and Sein et al.'s (2011) work that describes research methodologies for conducting design science research in information systems, Mantere & Ketokivi's (2013) framework to help researchers choose among different research strategies for organizational studies,) and Holmström, Ketokivi, and Hameri's (2009) introduction of design science as a method of discovery in operations management.

## Contribution:

We develop a research mode-contribution model for evaluating the accumulation of knowledge and apply it to interorganizational information systems (IOS) research. The evaluation shows that, despite expecting significant knowledge accumulation in IOS research, we found very little. The mode-contribution evaluation reveals that research on IOS is not in balance. Research efforts have focused on organizational theory contributions but lack in prescription and discovery. Knowledge of IOS impacts is currently limited when comparing it to knowledge on related organizational phenomena, such as adoption of IOS. As a consequence, IOS practices and designs are not linked to evidence on intervention design and impacts. The contribution should help researchers and research policy makers interested in improving the impact and relevance of information systems research.

With this paper, we hope to improve scientific processes for specific purposes in specific settings. More precisely, we provide a means to evaluate the basis of IS research from the perspective of knowledge structures and their accumulation. We propose that one can fruitfully see IS research, like any research in a domain with practical underpinnings, through the interplay among modes of research with distinct contributions; namely: 1) descriptions of discovery and exploration in IS, 2) elaborations of IS-based means and means-ends propositions, 3) IS-based designs, 4) explanations of the impacts and impact mechanisms of IS, and 5) organizational theories of IS-phenomena.

We illustrate the developed model by analyzing knowledge accumulation in research on interorganizational information systems (IOS) (Robey, Im, & Wareham, 2008; Naryanan, Maruchek, & Handfield, 2009). Following the basic work of Barret and Konsynski (1982), we broadly define IOS in this paper as systems that 1) involve resources shared between two or more organizations and 2) cross organizational boundaries. With its roots in the very formation of IS as a research domain of its own with one of the first key publications in *MIS Quarterly* (Barret & Konsynski, 1982), we see that IOS research offers both academically and practically relevant streams of research with enough time series and publication volume to analyze knowledge accumulation and diversity in research approaches and contributions. Furthermore, our explicit perspective on the accumulation and elaboration of different research contribution types adds to prior reviews of IOS research (see Kauffman & Walden, 2001; Chatterjee & Ravichandran, 2004; Elgarah et al., 2005; Robey et al., 2008; Narayanan et al., 2009). More generally, we expect to be able to generalize the findings from IOS research in terms of how one can study the accumulation and diversity of contributions both in IS but also more generally in different research domains.

This paper proceeds as follows. In Section 2, we develop a mode-contribution model of IS research. In section 3, we present the research methodology for the literature analysis. In Section 4, we use the model as a framework to analyze the structure of IOS research through 1982-2010 in terms of contribution types and knowledge accumulation. In Section 5, we discuss our results, limitations, and future research opportunities. Finally, in Section 6, we conclude the paper.

## 2 Mode-contribution Model of Research Knowledge Accumulation

Simon (1973) notes that, as “we move from pattern detection to prediction, we move from the theory of discovery processes to the theory of processes for testing laws”. This transition from initial insights into controlled testing of well-formed hypotheses forms a conceptually appealing and widely accepted depiction of the process of science over time in a given domain of interest (Hanson, 1958; Kuhn, 1962; Dubin, 1978; Stokes, 1997; Banker & Kauffman, 2004; Gregor, 2006; Arthur, 2007; Holmström et al., 2009; Taylor, Dillon, & Van Wingen, 2010).

Conventionally, researchers have distinguished between two distinct knowledge-creation modes in research proper: prescriptive and evaluation. Gibbons et al. (1994) distinguish cross-disciplinary research focused on solving real-world problems from research focused on knowledge defined in specific academic disciplines. In IS research, Hevner et al. (2004) recognize this divide by identifying two complementary paradigms: design science and organizational research. The field needs both modes of research, but they have different goals. In IS research, for the first goal is to determine what is effective, and for the second is to determine what is true (p. 98). Gregor (2006) acknowledges this divide by including theories of explanation/prediction and of design and action under the umbrella of theories in IS. van Aken (2004) similarly employs the same distinction by referring to organization theory, which results from description-driven research, as having an explanatory nature and as something to be used largely in a conceptual way, and to management theory, which results from prescription-driven research, as something to be used largely in an instrumental way for designing solutions for management problems.

Yet, a third mode warrants a comment: discovery. Essentially, this research mode involves investigations into topics where research has yet to formally describe the context of effort and not yet mapped and structured the constructs needed for theory development. Gregor (2006) captures the nature of this type of research using theories of analysis—focusing on describing “what is”—as a basis for further research efforts. In addition to the two widely acknowledged modes of research, we propose a third mode focused on discovery. In Figure 1, we present the three modes and their signature contributions in a mode-contribution model.

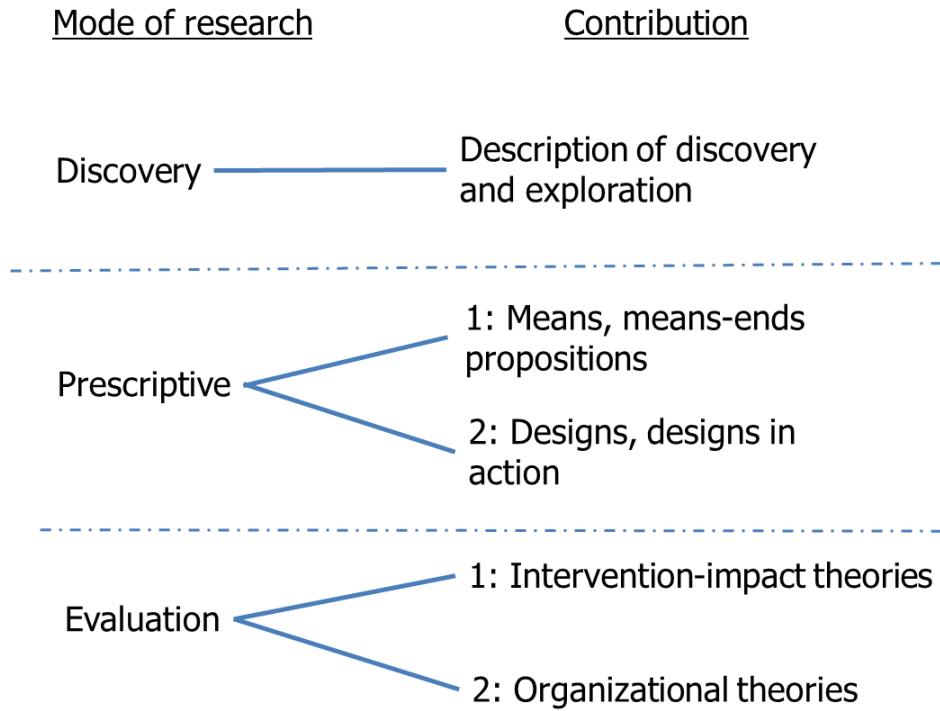


Figure 1. Mode-contribution Model of Research

Next, we elaborate the modes of IS research with particular focus on their distinct types of contributions. Each mode is necessary: discovery to keep a body of knowledge in IS both relevant and accumulating through the addition of new problems and relevant topics, prescription to increase the relevance of the body of knowledge, and evaluation to ensure that additions to the body of knowledge are rigorously tested and truly novel theoretical contributions.

## 2.1 Mode: Discovery Research

Nothing can come out of nothing; and, to add to bold guesses, one needs to explore the practice of affairs (i.e., the **discovery mode of research**). Building on his own work in cognitive psychology and artificial intelligence and the work of philosopher Norwood Hanson (1958), Simon (1973) strongly and explicitly disagreed with Karl Popper's (1961) opinion that scientific discovery has no logic. Stated differently, emerging phenomena are susceptible to scientific analysis. The nature of such efforts typically includes taxonomies, typologies, and frameworks (Gregor, 2006). In the operations management context, Handfield and Melnyk (1998) have elaborated discovery and description with two parallel proto-science contributions: 1) discovery to uncover areas for research and theory development ("what is going on here?", "is there something interesting enough to justify research?") and 2) description to explore ("what is here?", "what are the key issues?", "what is happening?").

In discovery research, researchers are possibly unsure what they are looking for and perhaps have only an intuition that something valuable might be going on. Perhaps a new form of industrial practice warrants a more rigorous investigation beyond anecdotal descriptions in the popular/trade press. One good example here is the study of the Japanese approach to manufacturing that several scholars discovered and initially mapped in the 1970s and 1980s (Schonberg, 2007). Another example concerns the way scholars brought activity-based costing to the arena of management studies (Kaplan, 1998). They started by describing a problem faced by managers—the limitations of existing cost-accounting methods—coupled with discovering an innovative approach to addressing this gap by certain industrial corporations such as the Schrader Bellows Group and John Deer Component Works (Jones & Dugdale, 2002).

## 2.2 Mode: Prescriptive Research

The impetus for knowledge accumulation in practice-related sciences stems directly or more indirectly from the problem of purposeful human action: the implementation of means to bring about a change with intended positive consequences in the context of the action. Bunge (1967b) holds that an act is rational if it is appropriate for the determined goal and if the goal and the means to reach it have been selected based on the best available knowledge; to be maximally rational, the choice should rest on scientific knowledge. Answering, with scientific methods, the question of what means are required for effective action is the central domain of **prescriptive research**.

The results of prescriptive research correspond to Gregor's (2006) category of theories of design and action (which say how to do something). Many of the most influential and widely cited theories in the wider domain of management (Corley & Gioia, 2011) address problems that practitioners face and have clear implications for design and action, such as contracting (transaction cost theory), organizational learning (systems theory), and decision making (prospect theory). Developing Gregor's framework further by integrating insights on design science by Simon (1996) and IS scholars (Walls et al., 1992; March & Smith, 1995; Hevner et al., 2004) and on prescriptive research from the domains of management (Romme, 2003; van Aken, 2004), operations management (Holmström et al., 2009), and philosophy of science (Bunge, 1967b; von Wright, 1971; Niiniluoto, 1993), we can identify two complementary perspectives interested in either means and means-ends propositions more generally or designs and designing per se.

### 2.2.1 Means and Means-Ends Propositions

One way in which Benbasat and Zmud's (1999) suggested research can be relevant is to be applicable, or to produce knowledge, and offer prescriptions that practitioners can use. Essentially, they address what van Aken (2004) calls improvement problems as compared to design and construction problems. Thus, research contributions of this type are instrumental knowledge for producing and manipulating natural and artificial systems (Niiniluoto, 1993). Means-ends propositions, or propositional statements that link given means to a certain end, encapsulate such knowledge (Holmström et al., 2009)

We argue that one needs to formulate the contribution, or stimulus for action (Ketokivi, 2008), of a theory as a prescription that pertains to the basic structure of practical action. Taking note of the fundamental concepts of means and ends, philosopher and logician Georg Henrik von Wright (1971) has suggested that, in explaining action, the practical inference has fundamental importance. Practical inference is, at its core, a teleological explanation that takes the form of a logical syllogism based on the intentions of the actor. Von Wright (1971, p. 27) elaborates the structure of practical inference as follows:

*[The] major premise of the syllogism mentions some wanted thing or end of action; the minor premise relates some action to this thing, roughly as a means to the end; the conclusion, finally, consists in use of this means to secure that end.*

Bunge (1967b) has proposed that "action-oriented research" (i.e., research that has bearing on action) should focus on the study of rules. Rules are "instruction[s] to perform a finite number of acts in a given order and with a given aim" (Bunge, 1967b, p. 132). Van Aken (2004, 2005) has employed Bunge's concept of technological rules and proposed that the study of rules—which vary from prescriptive statements such as "if you want to achieve Y in situation Z, then perform action X" to heuristic statements such as "if you want to achieve Y in situation Z, then something like action X will help"—form a focal point in research that focuses on producing practically relevant knowledge. Goldkuhl (2004), an IS researcher, denotes such statements as action prescriptions and upholds them as the fundamental type of practical knowledge (p. 63). Romme (2003) and Holmström et al. (2009) also emphasizes the key role of means-ends structures in management research that focuses on creating instrumental knowledge.

### 2.2.2 Designs and Designs in Action

Simon called for a "body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" (1996, p. 113); that is, studies concerned with the process of design (p. 111). IS scholars generally interpret design science in this way, and the interpretation constitutes the second type of contributions from prescriptive research: designs and designs in action. Thus, in the IS context, the results of such studies are theories that prescribe how one can carry out a design process in both an effective and feasible way (Walls et al., 1992) to improve IT performance (March and Smith 1995).



Some work has elaborated on how to conduct research with design contributions as we understand it here (i.e., research that deals with construction problems). Recent proposals include Hevner et al. (2004), Peffers et al. (2008), and Sein et al. (2011), the last of which contributes by taking an action research point of view (Baskerville & Myers, 2004). The definitive feature of design theories is their prescriptive nature. However, in contrast to prescriptive research with means-ends propositions as its key products, design studies contribute specific design principles or even blueprints of artifacts (Hevner et al., 2004).

The way Walls et al. (1992) and subsequent IS research (March & Smith, 1995; Markus, Majchrzak, & Gasser, 2002; Hevner et al., 2004; Goldkuhl, 2004; Gregor & Jones, 2007) have conceptualized design theory links the construction of artifacts and Walls et al.'s (1992) concept of normative theories to the overall means contribution type. Thus, design-oriented research addresses concrete artifacts by building theoretical, empirical, and internal grounding (Goldkuhl, 2004). Such theories are first and foremost interested in how to devise an artifact, or, in other words, they are interested in construction problems as opposed to improvement problems (van Aken, 2004). Gregor and Jones (2007) conceptualize design theories from the point of view that not only novel and tested artifacts constitute the contributions of design research. Based on Dubin (1978), they suggest eight specific dimensions on which knowledge of artifacts can accumulate: purpose and scope, key constructs, principles of form and function, artifact mutability, testable propositions, justificatory knowledge, principles of implementation, and expository instantiation.

## 2.3 Mode: Evaluation Research

**Evaluation research** corresponds to what Simon (2000, p. 360) calls theoretical science or the sociology of administration. Here, propositions purely describe: "Such and such a state of affairs is invariably accompanied by such and such conditions" (Simon, 2000, p. 356). Essentially, in evaluation research, one focuses on building "theoretical images of reality...essentially of its web of laws" (Bunge, 1967a, p. 28). One can also see evaluating and acknowledging previous research not only as the standard procedure that enables researchers to build a web of explanations but also the mechanism that creates a distinct research domain that persists over time (De Langhe, 2010). Evaluation research produces theories of explanation and prediction in Gregor's (2006) classification of IS theories (dealing essentially with how and why things are).

From the point of view of the application of technologies, we can identify two types of results of evaluation research: 1) theories of the impacts of IS and 2) theories of human activity related to the application of IS in organizations. Both are interested in explaining what happens and why; however, the former focuses on the specific types of explanations: what happens when one does X and why. Straub and Ang (2008) hold that understanding more about decision making about outsourcing offers only a marginal benefit to a practitioner. They note that such an understanding lacks a more specific explanation of the connection between outsourcing and organizational effectiveness. This difference between understanding decision making on outsourcing per se and understanding the mechanisms and impacts of outsourcing illustrates the divergent, yet complementary, natures of organizational and intervention-impact theories.

### 2.3.1 Intervention-impact Theories

Formal evaluation constitutes the basic outcome of research that contributes to creating intervention-impact theories (Pawson & Tilley, 1997). More generally, the logical structure of intervention-impact pertains to a particular structure (Denyer, Tranfield, & van Aken, 2008). Thus, a fully blown intervention-impact theory provides evidence that, in context **C**, intervention **I** results because of mechanism **M** in outcome **O** (**later CIMO**). Thus, tested impact-intervention theories are key groundings for means-ends propositions.

Following the CIMO logic, intervention-impact studies can have various foci. Thus, one form of research may focus on the outcomes of an intervention, another may study mechanisms as well, another may be explicit in contextualizing the outcome, and yet another type may take the interventions and outcomes as given and focus on the mechanisms. However, mechanisms are of fundamental importance for intervention-impact studies. Only if we understand why an intervention proposal works can we confidently make such proposals (Bunge, 1967b) and, thus, provide theoretical grounding (van Aken, 2004; Goldkuhl, 2004).

### 2.3.2 Organizational Theories

Organizational theories are kindred to impact-intervention studies in the sense that they, too, are explicitly interested in causal structures. However, their approaches differ in the sense that organizational theories focus on phenomena in general and not in the sense of purposeful outcomes of applications of an intervention. That is, while impact-intervention studies would study the effectiveness of a medical drug and its related contexts and mechanisms, studies with organizational theories as contributions would rather focus on the organization of clinical trials and incentives for developing new drugs. The knowledge interest is more explicitly in understanding than curing (Stokes, 1997). In the IS domain, such conceptual theories relate closely to the behavior of human agents in organizations as is more common in the sociological sciences vis-à-vis the natural sciences or sciences proper.

Arthur (2007) refers to phenomena mainly as natural phenomena—as effects that exist independently of humans and technology. However, we understand phenomena here more broadly as phenomena in relation to substantive theories: explanations of “how and why things are” in the context domain. Note the close potential link between mechanisms in impact-intervention theories and causal structures in organizational theories. If we know that A leads to B, we can try to reach B via A (Bunge, 1967b); that is, to harness a known phenomenon as a *modus operandi* for an intervention (Arthur, 2007). In the IS context, explanations as justificatory knowledge are commonly termed kernel theories (Gregor & Jones, 2007). Importantly, kernel theories are thought of as explanatory frameworks applied from other contexts (Walls et al., 1992).

## 3 Research Methodology

We conducted a structured literature review to collect data (see, e.g., Webster & Watson, 2002; Mathiassen, Saarinen, Tuunanen, & Rossi, 2007). To apply the developed model, we performed two sets of analyses on past published research with two sets of papers: 1) to categorize past research in terms of contribution types and 2) to assess more specifically the accumulation of research contributions in different modes of research. We performed these analyses based on samples of published IOS research: 1) a random sample and 2) a focused sample of highly cited works.

Following Barret and Konsynski (1982), we define IOS in this paper broadly as systems that 1) involve resources shared between two or more organizations and 2) cross organizational boundaries. Industrial organizations employ IOS for a multitude of interorganizational tasks though most notably for efficient transaction execution, effective information sharing, and integration of interorganizational processes (Schubert & Legner, 2011). The single most studied class of electronic trading systems in management information systems discourse is arguably electronic data interchange (EDI), which broadly refers to the “interorganizational exchange of business documentation in structured, machine-processable form” (Emmelhainz, 1990, p. 4). This commonly refers specifically to the application of EDI communication standards such as the EDIFACT and the ANSI X.12. However, besides older EDI-systems, new IOS approaches have emerged, such as Internet-based portals, contemporary system-to-system integration techniques, and frameworks that use the extensive markup language (XML) to name a few prominent ones. With a relatively long history both in practical (Kaufman, 1966) and academic (Barret & Konsynski, 1982) terms, IOS offers a good vantage point on the accumulation of an IS-related body of research.

### 3.1 Contribution-type Analysis

To perform the contribution-type analysis, we used a sample of IOS research papers that represented the variety of published IOS research over time. First, we searched papers from the Senior Scholars' basket of IS journals: *European Journal of Information Systems (EJIS)*, *Information Systems Journal (ISJ)*, *Information Systems Research (ISR)*, *Journal of Association for Information Systems (JAIS)*, *Journal of Information Technology (JIT)*, *Journal of Management Information Systems (JMIS)*, *Journal of Strategic Information Systems (JSIS)*, and *MIS Quarterly (MISQ)*. Specifically, we conducted a full text search for all published papers with the search term “interorganizational systems” for each journal. We used the search term because, although IOS come with many terms (e.g., extranets, EDI), researchers seem to dominantly use the term “interorganizational systems” (e.g., Robey et al., 2008). Thus, even if the paper itself did not use the term, it would, in order to be relevant and connect to prior works, at least cite other works that did.

We screened the initial search result (662 papers) based on paper titles and abstracts to include only papers that dealt specifically with IOS. We supplemented the resulting set of papers with results from a

search in ISI Web of Science databases with the term “interorganizational systems” in the title, abstract, or keywords, and ISI Web of Science keywords in the targeted journals. From this set, we screened out literature reviews, editorials, special issue/section editorials, and meta-analyses, which led to our removing 17 papers. Finally, we checked our search results against the search results of Robey et al.’s (2008) review in terms of journals used in our study and added 13 papers we had at that point not included. As a result, we had 189 IOS papers. For the actual analysis, we then randomly selected a fifth of this total by selecting a fifth of the papers for each decade (1980s, 1990s, and 2000s). Appendix A shows the papers we analyzed.

We extracted data from the papers by applying the principles of content analysis as Neuendorf (2002) proposes. Following Neuendorf, we developed a codebook (i.e., definitions of variables) and coding form (i.e., the instrument used to extract data) in several stages (Appendixes B and C show the codebook and coding form, respectively). After initially formulating the coding instruments, we conducted three iterative rounds of development using increasingly larger sets of selected papers considered *ex ante* that showed variety in analyzed terms. In each round, we independently coded the papers; discussed the results, refined the constructs, and reached consensus; and refined the coding instruments based on the results. We performed the third round on the sample of 38 papers from the secondary dataset. The coding instruments that we used in this round remained the same as in the final version, and, thus, we used the results of the third round in the data analysis.

The final version of the coding form was based on three variables: nature of the focal IOS construct, type of contribution, and role of a kernel theory in the paper. The first addressed the extent of the paper, such as a definite IOS artifact, defined as including technical details (e.g., a blueprint). The second set of variables addressed the main type of contribution of the study:

- Discovery/description: identifying the state of practical affairs.
- Means: main interest is in the use of an IOS-based means as such.
- Design: we considered a paper that focused on means as a design paper if it included a specific artifact.
- Impact intervention: main interest in evaluating the efficiency and effectiveness of IOS-based interventions either as such or as IOS-based interventions coupled with other types of interventions.
- Organizational theory: main interest in describing and/or explaining phenomena in general related to IOS utilization in organizations

These contributions map directly to the three modes of the mode-contribution framework (Figure 1): discovery/description to discovery, means and design to prescriptive, and intervention-impact and organizational theory to evaluation. Note that we distinguish the two different types of prescriptive contributions (means/means-ends propositions and designs/designs in action) through the construct of IOS artifact specificity: we considered prescriptive papers with a specific IOS artifact as design papers. We categorized other prescriptive papers (i.e., the ones that focused on IOS-based interventions more broadly rather than just developing a technical construct) as means/means-ends propositions (e.g., explicating an IOS-intervention, describing it better, providing meta-requirements for it, or otherwise elaborating an IOS-based intervention).

As a further remark on these constructs, we defined an intervention-impact study as a study primarily concerned with the impacts of IOS-based interventions (e.g., a study of causal models of what impacts an IOS-based intervention leads to, including the level of the impact and/or why such impacts follow from the utilization of the IOS-based intervention under study). In particular, the type of study in question deals not only with evaluation as Hevner et al. (2004) propose (i.e., proof of test for a constructed artifact) but focus on understanding the impacts of IOS-based interventions independently of whether the study developed the intervention it examined or whether the study focused on analyzing the impacts of a given intervention with a specific identity.

As for distinguishing the two types of evaluation mode contributions, the hallmark of intervention-impact outcomes is their explicit focus on the impacts of purposeful implementation of IOS (cf. clinical study of the effectiveness of a vaccine) in contrast to the study of other types of phenomena in the context of IOS (cf. sociological study of perceptions why a certain vaccine is/is not used in different groups), which is the focus of organizational theories.



As the process of developing the coding instruments showed, the instrumentation allowed us to categorize a paper as making multiple contributions because, in many instances, a paper had more than one main contribution.

Finally, the third set of variables addressed whether the papers used a kernel theory of IOS (Walls et al., 1992), a higher-level theory applied to the context to assess the state of theory development and link to other disciplines. Given our focus on IOS, any kernel theory we identified had to have initially been developed in a non-IOS-specific context, such as transaction cost economics (Williamson, 1996), which researchers have commonly used as a kernel theory for IOS studies (Elgarah et al., 2005). We incorporated the perspective of kernel theory based on the idea that a study that used a kernel theory signaled that it had a higher level of abstraction (because the application of a theory invariably also relates to the interpretation of the results of the study).

### 3.2 Knowledge-accumulation Analysis

To better view the accumulation of contributions and not just the frequency of each contribution type, we selected for analysis a set of highly cited papers with the assumption that impact in terms of citation count correlates with influence and further contribution to the accumulated body of knowledge. To have variation both in terms of publication date (accumulation of knowledge over time) and research paradigms—to counter the potential North American/European research biases (Benbasat & Weber, 1996)—we selected the top 5 cited research papers based on ISI Web of Science citation data, for three decades (1980s, 1990s, and 2000s) from both North American (*MISQ*, *ISR*, *JMIS*) and European (*EJIS*, *ISJ*, *JIT*, and *JSIS*) journals (as in the contribution analysis, we used the Senior Scholars' basket of IS journals, though we excluded *J AIS* because citation data were not available).

To find papers for the study, we searched the title, abstract, author keyword fields in Thomson ISI Web of Knowledge databases for the terms “interorganizational systems” and “electronic data interchange” (we added electronic data interchange as a search term because we used a narrower search focus than in our contribution-type analysis; that is, excluded full text). From the resulting 2,112 singular papers, we separated 149 papers published in the target journals. The ISI search was limited as SSCI and SCI databases run from only 1986 onwards (*JIT*, *JMIS*, and *MISQ* began before that), and because the ISI databases have indexed several journals only since the 1990s (*EJIS*, *ISJ*, *JIT*, *JSIS*) and 2000s (*JMIS*). Therefore, we supplemented the list of potential papers with five papers published in the 1980s in *ISR*, *JMIS*, and *MISQ* with a journal-based EBSCO search, and we used the EBSCO times-cited count, supplemented with Google Scholar, to select only more widely cited papers for the top five citation criterion. We left out papers that appeared in *JMIS* in the 1990s altogether because we used the ISI SSCI and SCI citation data for all papers in the 1990s and 2000s. We then pre-screened the final selection of included papers and excluded papers that matched all the selection criteria but still did not focus on IOS or were literature reviews/meta-studies. Appendix A shows the analyzed papers.

For the selected papers, a principal analyst, one of the authors, extracted the key thesis of each paper and the focal IOS construct for means-focused or IOS artifact-specific papers. The analyst used key theses and conceptualizations of IOS as points of reference to assess the contribution of each paper in terms of accumulation of academic knowledge on IOS utilization. A second analyst, one of the authors, checked the extractions and modified them based on discrepancies. Who also further categorized the papers under knowledge-accumulation analysis using the content analysis coding instrument to structure the presentation of the results.

## 4 Results

We present the results from our analysis in two sections. On Section 4.1, we address the categorization of 37 sampled IOS papers through contribution types. In Section 4.2, we examine the accumulation of knowledge with 24 well-cited IOS papers.

### 4.1 Contribution Types

Table 1 shows the results of the contribution analysis. From the total of 37 papers, around two thirds, or 25 papers, made a contribution to organizational theory. The next most common contribution type was impact studies, which we identified in one-third of the analyzed papers. Means and discovery contributions were the two next most common. Notably, we found only one design-oriented paper in the sample.

In terms of contribution types over time, the data show several interesting aspects. First, the proportion of organizational theory papers grew over time, and approximately 75 percent of the papers in the 2000s were in this category. This development appears along with a decline in the frequency of impact papers. While studies making this type of contribution were, along with organizational theory, the most typical contribution of research in the 1990s, in the 2000s, the share of papers with impact explanations dropped to one-fourth. Based on the analyzed data set, research in studied prestigious IS journals has aligned more with the norms of the social sciences and moved toward explaining phenomena around the artifacts and not focusing on the artifacts per se.

Second, and paralleling the increased frequency of organizational theory papers, an increasing number of papers applied kernel theory (i.e., the use of theoretical frameworks originally developed outside the IOS context). One can see this increase also as a form of legitimacy in that more research has relied on explanations with empirical power as a way to connect IOS research to the broader scientific community. The use of such theories makes IOS research more accessible, understandable, and palatable to researchers in other domains. Thus, we see how transaction cost economics, the most common frame in the analyzed papers, increasingly provides a theoretical backdrop against which to hypothesize. This development corresponds to the commonly advocated way of doing research in the management domain—from theory development to theory building and from low range to mid-range theories (e.g., Holmström et al., 2009).

To summarize, this analysis provides two insights. First, we observed a trend toward an increasing number of organizational theory-focused papers and an increased application of kernel theories. In particular, over time, an increasing number of papers made only an organizational theory contribution: in total, in the sample, 23 papers had a single contribution type; of these, 16 were of the organizational theory type and, of these 16, 14 were published after 2000. Second, in agreement with Hevner et al. (2004) and other information systems researchers, we found a conspicuous scarcity of design studies, and a relatively low frequency of papers with more general interests in IOS-based means compounded this lack of design studies. It seems that acceptable research in high-tier IS journals (which constitute the vanguard outlets of scientific efforts) focuses on organizational theories and the application of kernel theories. In this respect, IOS research does not demonstrate an exception, but rather confirms the state of affairs observed by other scholars (Holmström et al., 2009; van Aken, 2004; Romme, 2003) in the area of management studies.

**Table 1. Contribution Types and Use of Kernel Theories in IOS Research 1982-2009 (Sample of 37 Papers)**

	All		1980s		1990s		2000s	
Contribution								
Discovery	7	19%	0	0%	4	29%	3	15%
Means	7	19%	1	100%	4	29%	2	9%
Design	1	0%	0	0%	0	0%	1	5%
Impact	13	35%	0	0%	7	50%	6	27%
Organizational	25	68%	0	0%	8	57%	17	77%
<b>Total</b>	<b>37</b>		<b>1</b>	<b>100%</b>	<b>14</b>	<b>100%</b>	<b>22</b>	<b>100%</b>
Using kernel	19	51%	0	0%	5	36%	14	64%
<b>Total</b>	<b>37</b>	<b>100%</b>	<b>1</b>	<b>100%</b>	<b>14</b>	<b>100%</b>	<b>22</b>	<b>100%</b>

## 4.2 Knowledge Accumulation within and among Modes

To begin the knowledge-accumulation analysis, we categorized papers in a similar way as we did for the contribution-type analysis (Table 2). We found similar patterns: organizational phenomena papers showed the highest frequency, and we found a limited number of design papers (again, only one). Here, though, comparing the 1990s with the 2000s, we found no difference in terms of papers that used kernel theories. By adding the citation analysis in the sample, we could investigate how research in the different modes corresponded to expected patterns. We expected discovery to initiate prescription and evaluation research, research to evaluate prescription, and later research to elaborate on those evaluations, which would perhaps lead to new research in a discovery mode.

**Table 2. Contribution Types and Use of Kernel Theories in IOS Research 1982-2004 (Sample of 24 Highly Cited IOS Papers)**

	All		1980s		1990s		2000s	
Contribution								
Discovery	3	13%	1	25%	1	10%	1	10%
Means	6	25%	2	50%	2	20%	2	20%
Design	1	4%	1	25%	0	0%	0	0%
Impact	8	33%	2	50%	3	30%	3	30%
Organizational	11	46%	0	0%	5	50%	6	60%
<b>Total</b>	24	100%	4	100%	10	100%	10	100%
<b>Using kernel</b>	13	54%	1	25%	6	60%	6	60%
<b>Total</b>	24	100%	4	100%	10	100%	10	100%

We describe the results of the knowledge-accumulation analysis in Sections 4.2.1 to 4.2.3. The results align with those of the contribution-type analysis: organizational theory contributions were the most popular, whereas the data set contained only one design mode paper. Knowledge-accumulation analysis with deeper citation examination further revealed that organizational theory papers formed a tighter internal discourse, which supports knowledge accumulation in a more narrow knowledge domain. Based on our analysis, the organizational theory papers were the only subset of papers that built on and evaluated prior findings. In the studied knowledge domain (i.e., IOS), discovery seemed not to introduce new problems and topics for research, which indicates either limited renewal or alternative prompts for research on new problems and topics. Furthermore, the prescriptive mode did not exhibit knowledge accumulation, nor did such research lead to intervention-impact type studies.

#### 4.2.1 Discovery Mode

Table 3 shows highly cited papers in the discovery mode. The citation analysis adds the perspective of accumulation in a mode of research and among modes of research, which Table 4 summarizes. As the discovery mode focuses on introducing new problems and approaches, we expected other modes to cite discovery research, which we found in our results. The three papers represent three different openings; the two older ones (Johnston & Carrico, 1988; Webster, 1995) received citations from subsequent papers in the sample, which indicates that the discovery mode influences subsequent research.

**Table 3. Contributions in the Discovery Mode**

Paper	Discovery / description contribution
Johnston & Carrico (1988)	IT can be used to derive competitive advantage. Proposes that competitive advantage from IT deployments depend on 1) industry environmental factors, 2) integration of IT to internal strategies (three types of approaches proposed), 3) five internal conditions (e.g., leadership, integration of IT and strategy functions).
Webster (1995)	EDI might be used also for other than collaboration purposes (e.g., coercion/market dominance to further own purposes in an interorganization settings, and reasons for this kind of EDI use might stem from the competitive environment).
Howard et al. (2003)	Holds that it essential for the U.K. auto industry to move from a make-to-stock to build-to-order mode (the three-day car project), and, in this transition, IOS play an important role. Explicates barriers to IOS use for each member in the U.K. automotive supply chain.

Johnston and Carrico (1988) start from Porter's value chain analysis perspective and identify, based on fieldwork in eleven industries, the sources of IOS- and IT-based competitive advantages. The two other analyzed papers offer examples of how discovery type contributions have been reached through expert interviews on a novel phenomenon. Webster (1995) analyzes the use of EDI (in relation to suppliers) by Ford Europe/UK and the UK retail sector (a do-it-yourself chain called B&Q pursued similar EDI strategies as Ford). Her sources remain a bit ambiguous, but the work still fulfills the features of a discovery paper: highlighting the notion of coercion in EDI use through several specific examples. Howard, Vidgen, and

Powell (2003) explore the three-day car concept in the UK. In particular, they identify barriers to moving to an industry value chain-wide use of IOS using the case of a novel manufacturing concept. Despite being a highly cited paper, the work has not received further attention in the sample of papers.

**Table 4. Knowledge Accumulation Originating from Discovery Mode**

Paper	Discovery	Prescriptive		Evaluation		Further contributions
		Means-ends proposition	Design-in-action	Intervention-impact explanation	Organizational theory	
Johnston & Carrico (1988)		Johnston & Vitale (1988)			Sabherwal & Chan (2001)	2
Webster (1995)	Howard et al. (2003)	Howard et al. (2003)			Premkumar, Ramamurthy, & Crum (1997), Barrett (1999), Teo, Wei, & Benbasat (2003)	5
Howard et al. (2003)						0
Total further contributions						7
Within mode contributions						1
Share within mode						14.3%

#### 4.2.2 Prescriptive Mode

Papers identified in the mode of prescription primarily present a means-ends proposition. As Table 5 illustrates, other papers in the sample recognized these contributions, but they only limitedly further developed them. Indeed, we found no apparent knowledge accumulation in the prescriptive mode of IOS research (cf. Table 6). In the sample, each of the papers contributed in a different way to how IOS can be used as a means to achieve different ends, and, thus, they collectively elaborated on the concept from a practice perspective. The only work with a clear design contribution is Hansen and Hill's (1989) work on EDI. They developed concrete means (even a blueprint to some extent) for how to address audit and control issues in information systems that span many organizations.

**Table 5. Contributions in the Prescriptive Mode**

Paper	Means/means-ends proposition contribution
Barret & Konsynski (1982)	Details five IOS usage patterns (levels of participation in IOS networks): 1) remote input/output node, 2) application processing node, 3) multi-participant exchange node, 4) network control node, 5) integration network node.
Johnston & Vitale (1988)	Suggests that one should deploy IOS by asking several questions: 1) why (i.e., business purpose), 2) who (with whom), 3) what (information function), 4) how (what particular impact targeted).
Kumar & van Dissel (1996)	Posits three kinds of IOS: pooled, supply/value chain, and networked. Holds that there are risks involved in IOS usage. Proposes strategies to manage risks (e.g., neutral third party as the IOS controller (p. 291) or the use of open standards (p. 293).
Masseti & Zmud (1996)	Suggests a framework to measure and guide EDI usage with the dimensions of volume, depth, breadth, and diversity.
Allen, Colligan, Finnie, & Kern (2000)	Suggests means to develop better/more successful IOS (e.g., through communication, end user training, management of expectations (p. 28), that helped in develop the TransLease system).
Howard et al. (2003)	Develops a framework of idiosyncratic barriers to IOS use in three-day car supply chain for each supply chain tier.
Hansen & Hill (1989)	Holds that EDI leads to challenges in audit and control issues. Provides a set of specific suggestions how to counter "programmed routines that match control documents" (to address the concern of payment validation) (p. 140).

Table 6. Knowledge Accumulation Originating from Prescriptive Mode

	Paper	Discovery	Prescriptive		Evaluation		Further contributions
		<i>Description contribution</i>	<i>Means-ends proposition</i>	<i>Design-in-action</i>	<i>Intervention-impact explanation</i>	<i>Organizational theory</i>	
Means-ends	Barret & Konsynski (1982)	Howard et al. (2003)	Howard et al. (2003)		Bakos (1991)	Bensaou & Venkatraman (1996), Iacovou et al. (1995)	5
	Johnston & Vitale (1988)				Holland (1995)	Bensaou & Venkatraman (1996), Sabherwal & Chan (2001)	3
	Kumar & van Dissel (1996)	Howard et al. (2003)	Allen et al. (2000), Howard et al. (2003)				3
	Masseti & Zmud (1996)				Subramani (2004)		1
	Allen, Colligan, Finnie, & Kern (2000)						0
	Howard et al. (2003)						0
Design-in action	Hansen & Hill (1989)					Premkumar et al. (1997)	1
	Total further contributions						12
	Within mode contributions						3
	Share within mode						25%

### 4.2.3 Evaluation Mode

As we found in the contribution analysis (see Section 4.1.), the dominant mode was evaluation; and organizational theory contributions dominated over intervention-impact explanations (Table 7). In analyzing further contributions by the intervention-impact evaluations, we found that the eight papers, while related, can be seen as a relatively loose set; they made only four internal citations (Table 8). As for why, one reason may concern their loosely defined central constructs. Indeed, these studies showed clearly how IOS are not a single means but rather a platform of kindred means. Furthermore, the highly cited intervention-impact research did not evaluate highly cited prescriptive research. Instead, the evaluation studies focused more on either loosely defined constructs of IOS (to obtain larger samples) and statistically significant results from survey-based studies, or they investigated accessible examples using case study methods. They lacked further development of means-ends propositions through field testing, which could contribute contextualized explanations of observed outcomes.

Adoption constitutes the penetrating theme in the organizational theory papers. As one might expect, this body of studies demonstrated more knowledge accumulation than the other modes of research and also more than the intervention-impact papers. This set of papers builds a growing understanding of why IOS are adopted (or not adopted) and what determines successful adoption. The angles added over time include acknowledgement of stakeholder perspectives (Barret, 1999; Allen et al., 2000) and institutional perspective (Teo et al., 2003). We also found one direct test: Chwelos, Benbasat, and Dexter (2001) used (in a survey) Iacovou, Benbasat, and Dexter's (1995) inductive case study as a basis on which to build a hypothesis.



**Table 7. Contributions in the Evaluation Mode**

<b>Paper</b>	<b>Intervention-impact explanation contribution</b>
Johnston & Vitale (1988)	IOS led to competitive advantage. Suggests impacts on 1) search-related cost, 2) unique product features, 3) switching costs, 4) internal efficiency, 5) interorganizational efficiency.
Johnston & Carrico (1988)	IT can be used to derive competitive advantage. Proposes that competitive advantage from IT deployments depend on 1) industry environmental factors, 2) integration of IT to internal strategies (three types of approaches proposed), 3) five internal conditions (e.g., leadership, integration of IT and strategy functions).
Bakos (1991)	Electronic markets lower buyer search costs and change buyer-selling market power.
Holland (1995)	Companies can use IOS to coordinate their supply chains; that is, the motivation to build virtual hierarchies (rather than electronic markets). The need to coordinate stems from market issues (e.g., rapid changes in demand, high demands in product quality).
Mukhopadhyay, Kekre, & Kalathur (1995)	EDI leads to operational level business benefits (decreases coordination costs). The authors estimate the value for Chrysler using EDI towards its suppliers at a 100 dollars/vehicle/year.
Gallivan & Depledge (2003)	Trust has been too simplistically conceptualized in past research: there is actually a need for trust and the level of trust. IOS use can be related to trust building and/or monitoring (control purpose). In addition, trust and control are inversely related (a casual model suggested).
Subramani (2004)	Proposes two patterns of IOS use—exploration and exploitation—and that benefits from IOS for (non-initiating) trading partner depend on relation specific investments.
Barua, Konana, & Whinston (2004)	Non-copyable “net-enabled” IT-based capabilities lead to financial performance.
Iacovou et al. (1995)	EDI adoption (esp. among SMEs) explained the factors of organizational readiness, and perceived benefits, and external pressure and EDI partner expansion plans can be defined to expand adoption.
Bensaou & Venkatraman (1996)	An organization needs to fit its information-processing needs with its information-processing capabilities in order to maximize business performance.
Kumar & van Dissel (1996)	IOS usage involves risks. The type of used determined by interorganizational interdependency structure and the interdependency drives risks of IOS. Also posits that collaborative alliances explained by economic, technical, and socio-political factors.
Premkumar et al. (1997)	EDI adoption explained by environmental, organizational, and innovation (e.g., its relative advantage) features. Specifies 11 detailed potential factors of which size, competitive pressure, customer support, and management support receive empirical collaboration.
Barrett (1999)	Studies the LIMNET EPS EDI system and attributes problems in the system adoption in differences in the perceptions of IT professionals, senior managers, and users in terms of the system use; categorizes differences under three “domains”.
Johnston & Gregor (2000)	Suggests that it is relevant to examine IOS adoption at the industry level. Proposes a theoretical frame to do so. Key issues related to IOS adoption include situational/interaction routines.
Allen et al. (2000)	The expectations of the stakeholders must be “managed” for IOS to be successfully deployed. IOS success affected also by “softer issues” (i.e., shared objectives, power, data and code standards, understanding).
Chwelos et al. (2001)	Intent to adopt EDI explained by external pressure, perceived benefits, and organizational readiness (a detailed model included). Finds empirical support for the model.
Sabherwal & Chan (2001)	Business performance follows from aligning business strategy with IS strategy. Gives specific profiles on each business strategy and related IS use profile. Finds empirical support for two of the three proposed strategy profiles.
Zhu, Mu, & Shaw (2003)	Intent to adopt e-business driven by technological, organizational, and environmental factors (discloses a detailed model). Observes also that, in “high e-business intensity” countries, firm size, consumer readiness, and lack of trading partner readiness less significant.
Teo et al. (2003)	Intent to adopt IOS explained by institutional aspects (coercive, normative, and mimetic pressures).

**Table 8. Knowledge Accumulation Originating from Evaluation Mode**

	Paper	Discovery	Prescriptive		Evaluation		Further contributions
		Description contribution	Means-ends proposition	Design-in-action	Intervention-impact explanation	Organizational theory	
Intervention-impact explanation	Johnston & Vitale (1988)				Holland (1995)	Bensaou & Venkatraman (1996), Sabherwal & Chan (2001)	3
	Johnston & Carrico (1988)		Johnston & Vitale (1988)		Johnston & Vitale (1988)	Sabherwal & Chan (2001)	3
	Holland (1995)	Howard et al. (2003)	Howard et al. (2003)			Premkumar et al. (1997)	3
	Bakos (1991)		Masseti & Zmud (1996)				1
	Mukhopadhyay et al. (1995)		Masseti & Zmud (1996), Allen et al. (2000)		Subramani (2004), Barua et al. (2004)	Premkumar et al. (1997), Barrett (1999) Allen et al. (2000), Chwelos et al. (2001)	8
	Gallivan & Depledge (2003)						0
	Subramani (2004)						0
	Barua et al. (2004)						0
Organizational theory	Bensaou & Venkatraman (1996)		Allen et al. (2000)			Holland (1995), Allen et al. (2000), Chwelos et al. (2001)	4
	Premkumar et al. (1997)					Barrett (1999), Zhu et al. (2003), Chwelos et al. (2001)	4
	Barrett (1999)						0
	Iacovou et al. (1995)				Masseti & Zmud (1996), Barua et al. (2004)	Premkumar et al. (1997), Barrett (1999), Zhu et al. (2003), Chwelos et al. (2001)	6
	Kumar & van Dissel (1996)	Howard et al. (2003)	Allen et al. (2000), Howard et al. (2003)			Allen et al. (2000)	4
	Johnston & Gregor (2000)						0
	Allen et al. (2000)						0
	Zhu et al. (2003)						0
	Chwelos et al. (2001)				Subramani (2004), Barua et al. (2004)	Teo et al. (2003)	3
	Sabherwal and Chan (2001)				Subramani (2004)		1
	Teo et al. (2003)						0
	Total further contributions						40
	Within mode contributions						30
	Share within mode						75%

## 5 Results

Research on IOS in high-tier information systems journal outlets has increasingly shifted to organizational theory-type contributions that focus on explanations by applying kernel theories from other discourses. While papers that deal with phenomena such as the adoption of IOS build and advance knowledge on specific phenomena under study, knowledge of IOS use and design in general has not accumulated because little research has focused on IOS design and the impacts of design choices. This finding concurs with the expectations of Straub and Ang (2008), who note that academics favor explanations of phenomena over prescriptions and design knowledge to solve problems. It may be that high-tier journal outlets focus on phenomena of general interest and leave papers about building and evaluation to other outlets. However, this presumed division of labor is a potential problem; we have no forum or mechanism for the accumulation of results that address the different relevant aspects of theory. Only recently have IS researchers published papers that also give more detailed guidance regarding the accumulation of results; see, for example, Peffers et al. (2008) and Sein et al. (2011).

Gregor's (2006) distinction between different types of theory recognizes the different ways in which research can contribute to theory—an important and constructive starting point for addressing the problem of rigor and relevance because it offers the basis for developing a better understanding of how research can be combined and presented in such a way that its results are cumulative. As Benbasat and Zmud (1999) note, without complementary results, research cannot develop theoretical models as a basis for suggesting prescriptive action for practice. Complementing Gregor's work, our work provides a new angle by explicating the need to link different research modes and their contributions. Moreover, as an addition to Gregor's work, we distinguish between types of design-oriented studies (means vs. designs) and theoretical explanations (impact intervention vs. organizational).

Science needs strong incentives for conducting cross-disciplinary research and bridging established research domains (De Langhe, 2010) because scientific research is a network industry with strong positive feedback (Arthur, 1989), which can encourage researchers to conform and follow the direction of peers to increase their impact and publication opportunities in highly cited journals. Positive feedback in research eliminates alternatives over the long term and causes dominant paradigms to rise, which researchers need to actively counter and overturn to enable innovation and renewal (Kuhn, 1962). The detrimental effect of positive feedback on theoretical contributions is that a research domain will follow a suboptimal path that leads to declining practical usefulness and to a paucity of original and revelatory accounts over time. Corley and Gioia (2011) note the crucial role of editorial teams in top-tier journals for maintaining a stream of contributions that not only are significant to the discourse of a research domain but also enhance the relevance of theory to practice. Similarly, Taylor et al. (2010) argue that information systems as a scientific discipline should maintain a healthy tension in which evaluation research and prescriptive research are intertwined such that it would be difficult to classify particular research projects as entirely representative of one type of contribution or the other.

We propose that our framework (Figure 1) of the contributions of IS research provides a tool for assessing the balance and composition of research in a given set of literature. By applying the framework, researchers in a specialized domain can understand the current state and balance of research. This understanding should help editorial teams and the editors of special issues to provide guidance to potential contributors and reviewers in terms of the type of research in demand in specific area(s). Furthermore, we argue that one can apply our framework when developing meta-level research plans that strike a balance between renewal and incremental accumulation, such as national or multi-national level research programs, and helps one structure such efforts so that the accumulation of knowledge is balanced among discovery, prescription, and evaluation. Applying our framework in this way should also have an impact on the debate about relevance in the IS research community. More balanced research will better serve both academia and industry in terms of research activities and contributions.

### 5.1 Limitations

This study has several limitations. First, it has limitations that concern how we designed the literature review. Although we strived to nearly comprehensively review the IOS literature, we also acknowledge that our review likely has gaps. These gaps emerge, first, from the selected pool of journals. In this paper, we focused on the eight journals in the Senior Scholars' basket of IS journals. These journals represent the high-tier journals in the field. However, as our own analysis shows, such a focus on the high-tier journals may not be adequate because some outcomes of knowledge accumulation may be reported in

other academic outlets. Thus, we see that we need to test the framework with a wider selection of journals and other research outlets so as to construct a more comprehensive view. However, we see that the current selection of journals and papers demonstrates the applicability of the framework and, thus, provides a “proof-of-concept” validation. In addition, the results do show an imbalance in the research contributions published in the eight selected journals, which further supports our argument for a more balanced accumulation of contributions.

Second, our approach to limiting the sample of analyzed papers makes our results less representative of IOS research in general, though the results are illustrative in terms of the theoretical framework advanced. We found negative results regarding the proposed mode-contribution model of research for research on IOS. We found imbalances among modes of research, and contributions have not accumulated. As the sample investigated is small in relation to the full body of research, we must ask if a full investigation of the research domain would change the results? Precisely because our findings are negative and relate to a research domain as a whole, it is not likely that the research left out of the analysis would differ in terms of mode and contribution. We also have no reason to believe that less-cited research would more systematically accumulate contributions across modes from discovery to prescription/evaluation. Even if we analyzed the entire body of research on IOS, we believe we would obtain the same results. Moreover, the converging frequencies of contribution categorizations that emerge from two independently selected samples support the external validity of the results.

Third, a final limitation concerns the contribution-type categorization: our results represent, to a certain extent, our subjective interpretation of the reviewed papers. This bias is inherent in all similar studies and cannot be completely avoided. However, we have tried to minimize this bias by following and applying a formal three-step data-extraction process and by coding. We are satisfied that our approach meets the demands of rigor expected in the literature for such literature-codification exercises (Webster & Watson, 2002) and for careful content analysis (Neuendorf, 2002).

## 5.2 Future Research

In future research, we encourage IS researchers to address the imbalance we recognize here, and we encourage both design and intervention-impact oriented research in combination to address phenomena of interest to academia. A return to more basic questions of how to design and to the effects of design need not reduce ambitions from the perspective of the phenomena investigated. The opportunities to combine design and organizational phenomena are particularly good in the IOS domain. To design better IOS interventions, the perspective of ensemble design—which combines the interactions of many designers—is highly relevant (Sein et al., 2011). Similarly, the impact of the same IOS intervention differs depending on the perspective, which creates interesting links to the literature on service science research (Ostrom et al., 2010). Finally, we also call on researchers to apply our framework of contributions to the accumulation of knowledge to different research domains to further validate it and to determine whether it can be revised or extended to accommodate other fields of literature besides IOS. It would be useful, for example, to compare how the decision support systems literature (see Arnott & Pervan, 2014) compares to IOS literature and whether the modes of research and knowledge accumulation differ due, for example, to the more complex nature of designing IOS versus decision support systems<sup>1</sup>. An issue of general interest to artifact-related domains of research is that of the possibly different modes required to establish a new domain of research and to develop a domain to maturity. Our hypothesis—that further research needs to test—is that discovery and prescriptive contributions are required in addition to description to establish interest in a domain, whereas evaluation is sufficient to maintain interest once a domain has been established. There are significant research policy implications of this knowledge accumulation for the establishment of new areas of practically relevant research.

## 6 Conclusion

A scientific discourse needs a balance between research modes. We note that the current emphasis in IOS research has been predominantly on organizational theories as has been the case with information systems research more broadly (Hevner et al., 2004). On a positive note, we can see that IOS research has retained a capacity for discovery, which is necessary for continuously evolving communications technologies. We argue that, with more balanced research modes, we can accumulate a more coherent

<sup>1</sup> We thank an anonymous reviewer for this suggestion.

body of knowledge in this domain of human action, especially in the context of *technochange* (i.e., technologically driven organizational change) in the high-risk but potentially high-reward context that concerns using novel IT to change organizations for the better (Markus, 2004). The accumulation of scientific knowledge is based on a balance of complementary research contributions. Based on our analysis, the IOS literature has not evolved in this way. Knowledge of means/design/intervention is lacking in comparison to accumulated knowledge of associated phenomena, such as the adoption of IOS. Thus, insights into newly discovered phenomena and design and into well-understood phenomena such as adoption need to be combined with evidence on intervention design and impacts.



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## Appendix A: Analyzed Papers

**Table A1. Contribution-analysis Papers**

Contribution-analysis papers	Categorization				
	Disc	M.	Des.	Int.	Beh.
Barret & Konsynski (1982)		x			
Suomi (1992)		x			
Boon (1992)				x	
Riggins & Mukhopadhyay (1994)				x	
Hess et al. (1994)				x	x
Cavaye & Cragg (1995)		x			x
Meier (1995)	x	x			
Lee & Clark (1996)	x			x	x
Cavaye (1997)	x	x			
Chatfield & Bjorn-Andersen (1997)				x	
Chau & Tam (1997)	x				x
Choudhury, Hartzel, & Konsynski (1998)				x	x
Johnston & Gregor (2000)					x
Nakayama (2000)				x	x
Chircu & Kauffman (2000)					x
Giaglis, Klein, & O'Keefe (2002)					x
Caldeira & Ward (2002)					x
Pavlou (2002)					x
Lee (2003)	x	x		x	
Teo & Ranganathan (2003)					x
Hsiao (2003)					x
Buxmann, von Ahsen, Diaz, & Wolf (2004)	x				
Konsynski & Tiwana (2004)					x
Gosain, Malhotra, & El Sawy (2004)		x			x
Kunsoo et al. (2004)					x
Barua et al. (2004)				x	x
Jaspersen, Carter, & Zmud (2005)					x
Zhu, Dong, Xu, & Kraemer (2006)				x	x
Patnayakuni, Rai, & Seth (2006)					x
Bharadwaj, Bharadwaj, & Bendoly (2007)				x	
Sutton, Hampton, Khazanchi, & Arnold (2007)					x
Zhao et al. (2007)					x
Schemm & Legner (2008)	x		x	x	
Rodon, Pastor, Sese, & Christiaanse (2008)					x
Charki & Josserand (2008)				x	
Redondo, Daniel, & Ward (2009)					x
Ibrahim & Ribbers (2009)					x

Note: papers ordered by publication year.  
 Disc: discovery, M: means, Des: design (means with specific IOS), Imp: intervention-impact organization, Beh: theory.

**Table A2. Accumulation-analysis Papers**

<b>Accumulation-analysis papers</b>		<b>Categorization</b>			
<b>Reference</b>	<b>Disc</b>	<b>M.</b>	<b>Des.</b>	<b>Int.</b>	<b>Beh.</b>
Barret & Konsynski (1982)		x			
Johnston & Vitale (1988)		x		x	
Johnston & Carrico (1988)	x			x	
Hansen & Hill (1989)			x		
Webster (1995)	x				
Holland (1995)				x	
Bensaou & Venkatraman (1996)					x
Premkumar et al. (1997)					x
Barrett (1999)					x
Bakos (1991)				x	
Iacovou et al. (1995)					x
Mukhopadhyay et al. (1995)				x	
Kumar & van Dissel (1996)		x			x
Masseti & Zmud (1996)		x			
Johnston & Gregor (2000)					x
Allen et al. (2000)		x			x
Zhu et al. (2003)					x
Gallivan & Depledge (2003)				x	
Howard et al. (2003)	x	x			
Chwelos et al. (2001)					x
Sabherwal & Chan (2001)					x
Teo et al. (2003)					x
Subramani (2004)				x	
Barua et al. (2004)				x	
Note: papers ordered by decade and geographical strata (European journals in bold). Disc: discovery, M: means, Des: design (means with specific IOS), Imp: intervention-impact organization, Beh: theory.					

## Appendix B: Codebook

### 1. IOS artifact specificity

The purpose of this question is to extract data on the specificity of the focal IOS-based construct in the paper. The IOS-based construct in the study is considered specific if the study includes a technical description of an IOS-based artifact, such as software, server, database, network, messaging structure, or name.

### 2. Type of study outcome

1. **Discovery/description:** a study that focuses on advancing the academic research field by describing and discovering the world of practical affairs. There is a limited body of knowledge of the field at which the discovery focuses on. One important focus of such a study could be to outline research agendas. Such a study can relate, for example, case examples of the use of various types of IOS, good practices of IOS use, observations of challenges related to using IOS, or observations on other phenomena in the context of the use of IOS.
2. **Means:** a study that focuses on IOS-based means. Such a paper mainly focuses on studying, building, or evaluating specific IOS-based means. Its purpose can also be to contribute to a better understanding of IOS-based means by, for example, explicating an IOS-based means in general, describing an IOS-based means in more detail, or otherwise elaborating an IOS-based means.
3. **Intervention-impacts:** a study that focuses on the impacts resulting from the implementation of an IOS-based means (i.e., intervention). Such a study basically focuses on describing and/or explaining the consequences of purposeful use of IOS-based interventions. This type of study evaluates the efficiency and effectiveness of IOS-based interventions either as such or as IOS-based interventions coupled with other types of interventions. The IOS-based intervention whose impact is studied need not be a specific instance of an IOS-based intervention; it can also be a certain type of IOS-based intervention in general. Purely conceptual (and, thus, hypothetical) discussions of the impacts of IOS-based interventions do not count in this category.
4. **Organizational theory:** a study that focuses on phenomena in the context of the use of IOS. The basic characteristic of such a study is its main interest in describing and/or explaining phenomena generally related to IOS utilization.

### 3. Kernel theory

The purpose of this question is to extract data on whether the paper applies a more general theory to the context of IOS. The applied theory does not as such address IOS.

For our writing style guidelines, please see link etc.

## Appendix C: Coding Form

**Guide: enter value for the gray cells**

Definitions of variables given in the Codebook.

<b>Paper ID</b>		
<b>1. IOIS Artifact specificity</b>		
	Does the paper include a specific IOIS-based artifact?	[yes/no]
<b>2. Type of outcome</b>		
	What of the following best describes the paper in terms of its outcome? [multiple selection possible]	<ul style="list-style-type: none"> <li>• Discovery/description</li> <li>• Means-End/Means</li> <li>• Impact-intervention</li> <li>• Organizational theory</li> <li>• Other</li> </ul>
<b>3. Kernel theory</b>		
	Does the paper apply a higher level theory to the context of IOISs?	[yes/no]

**Figure 2. Coding Form**

Note: in the original coding form, we used “behavioral theory” instead of “organizational theory” and “means” instead of “means-ends/means”. We changed the terminology in the form to reflect the current uses of the terms in the paper. However, this change has no implications for the coding itself as the terminology changes only clarify our original intent regarding how to apply the coding form.



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